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THE FLOODS IN THE SOUTH OF FRANCE.

GREAT disasters wherever they occur always command British sympathy and, if need be, usually obtain important pecuniary aid. While any help which we could obtain would hardly be more than a drop compared with the stream of disaster which has swept down the valleys of the northern slope of the Pyrenees, we cannot write upon the subject without in the first place assuring our readers that the loss is most serious. Englishmen have no idea of what a flood means; perhaps the statement by Prof. Raulin that, at Langon, the flood was 38 ft. in height, will give the best idea of what a disaster the late one has been. Suppose we had a 38 ft. flood in the Thames it would cover the whole of—

South bank... Battersea Park, Lambeth, Southwark, Bermondsey, Deptford.

North bank.. Fulham, Chelsea, Brompton, Belgravia, Westminster, St. James's Park,

while as for the new Embankment, a steamer might ply over the top of it. Happily for us, we have no Pyrenees at the head of the Thames and need fear no such disaster, but we can sympathize with our neighbours, and many of our readers can, and we trust will, help them.

On hearing of the disaster we wrote our distinguished *collaborateur*, Professor Raulin, for particulars. He has kindly sent us a most interesting reply, of which the following is a translation :—

MY DEAR SIR,—Immediately after the receipt of your letter I read over all the accounts in the journals, and transmit herewith all the general indications which I have collected. The daily and monthly amounts of rainfall have not yet been received.

The inundation, even more disastrous than that of 1855, which has ravaged the valleys of the south-west of France between June 22nd and 28th has been occasioned by torrential rains, and by snow falling during the three or four preceding days, especially on the northern slopes of the Pyrenees at the head of the Adour, the Garonne, the Aude, and some other small tributaries of the Mediterranean.

The rains also prevailed over the adjacent high lands of the plains of Gascony, in the centre of which are the heads of various affluents of the Garonne, and again to the N. of the eastern half of the Pyrenees

on the Black Mountain at the head of the Tarn, one of the principal affluents (on the right hand) of the Garonne.

But these rains did not extend to the central plateau of France, nor further than to the northern part of the plains of Gascony, for on the one hand the Lot, which descends from the first and crosses the second, has not been in the least flood, any more than the Drot, which is in the N.W. Again, at Bordeaux the rainfall was quite ordinary, that of the 20th and 21st (even including the small subsequent fall up to the 29th) being *under one inch.*

On the southern slope of the Pyrenees not a drop of rain fell, and the sky was cloudless except in the north, where the Spanish observers saw a persistent belt of clouds.

All the French valleys which furrow the country above indicated have been inundated, but it is in the valley of the Garonne rather than in that of any one of its affluents that the greatest disasters have occurred, because at its junction with the Tarn near Moissac it collects the waters of a great number of tributary streams—those of nearly half the length of the Pyrenees, and of the eastern part of its basin. Over most of the course the floods acquired a height and volume greater than those in 1855, and as that is 20 years since, the principal flood was a very long time descending from the head of the valley to the sea at Bordeaux. According to the Engineers of the *Ponts et Chaussées*, the following are the data of the Inundation wave in the Garonne :—

Station.	Time of highest flood.	Greatest elevation.
Cazères ...	June 23rd, 7 a.m.	... 18 ft.
Toulouse ...	,, ,, 10 p.m.	... 24 ,,
Agen ...	,, 25th, 9 p.m.	... 37 ,,
La Réole ...	,, 26th, 4 a.m.	... 34 ,,
Langon ...	,, ,, 9 p.m.	... 38 ,,
Bordeaux ...	,, ,, (?27th) 2 a.m.	... affected by tide.

The floods of the upper Garonne and of the Tarn, which separately rose to 24 ft. and to 23 ft. at Toulouse and at Montauban, attained after their junction below Moissac, at Agen, and at Langon, a height of 36 ft. to 39 ft., which would have been even greater below Agen if the rains had unhappily extended to the watershed of the Lot.

The inundation wave took *three days and a half* to descend from Cazères, at the foot of the mountains, to the lower parts where, as at Langon, the tide begins to be felt : that is to say, 86 hours for about 155 miles, or a mean progress of less than *two miles per hour.*

A system of telegraphic warnings previously well organized in each principal valley would have been of great utility, could have given useful warnings, and would have materially lessened our losses. How many precautions might have been taken in the country between Cazères and Langon, and even Bordeaux, distant more than 155 miles, during the 86 hours between the occurrence of the maximum flood at Cazères on the 23rd at 7 a.m., and its arrival at Langon on the 26th at 9 p.m.—Yours very truly,

V. RAULIN.

Bordeaux, July 2nd, 1875.

It was our intention to have given a map of the district, and to have entered fully upon the consideration of the subject, but it seems better to postpone it until Prof. Raulin has received the rain returns from his stations, many of which are admirably placed for the purposes of this enquiry.

We cannot, however, leave the subject even temporarily without supporting most heartily Prof. Raulin's remarks on the necessity of organizing a system of warnings like those now in operation for Lyons and for Paris.

WHIRLWIND AT BALDOCK, HERTFORDSHIRE.

On the morning of June 15th the following paragraph appeared in *The Times*:—

Mr. E. Smith writes to us from Baldock, Hertfordshire:—"Some of your readers may be interested to know that this place was visited during the afternoon of Saturday by a wind of extraordinary strength and fury for so inland a situation. About 1 o'clock a brief thunderstorm, culminating in one loud cracking peal, passed over the town from the south-west, and shortly afterwards, and in its wake, a very low and gloomy cloud was seen to be approaching with remarkable velocity. The cloud appeared to be of a hollow or perhaps spiral shape, horizontally inclined, with a huge whirling tail; indeed was so monstrous and furious in its aspect as to be positively terrible. Immediately the air near it was observed to be filled with branches and leaves of trees, slates, stones, dust, &c. The phenomenon came on with awful energy across Mr. Thomas Pryor's park and the upper part of High-street, close to the ground, and in about a minute more was passed and gone, leaving behind it a sulphurous smell. Then it was discovered that not only had the wind dismembered and uprooted several large trees in its course, but had thrown down the greater portion of an extensive block of modern and valuable maltings belonging to Mr. Pryor, and situated in a somewhat sheltered corner in the rear of his park, causing a loss which I am sorry to say £1000 will barely cover. The whirlwind seems to have been only a few yards in diameter, and its course, which was somewhat circular, from S.W. to N.E. [1] As lightning itself so often does, the storm showed in its effects a remarkable caprice; but happily no injuries to life or limb occurred, although one or two persons had a narrow escape."

Knowing the locality and some of the gentlemen mentioned, we were satisfied of the authenticity of the statement, and therefore started at once for Baldock, and spent a day in thoroughly examining the effects of the whirlwind. As we desire to devote our space chiefly to the consideration of the manner in which these effects were produced, we avail ourselves, as far as possible, of descriptions of them by other persons. We, therefore, next reprint the account given in the *Hertfordshire Express*, appending to it, as we have done to Mr. Smith's, foot notes, critical and explanatory. On the whole, both accounts are very good.

EXTRAORDINARY STORM OF WIND AT BALDOCK.

A hurricane, the like of which is not remembered by the oldest inhabitant, passed over the town of Baldock on Saturday last, causing, in its impetuous and resistless course, a very considerable amount of damage. The cyclone approached

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[1] The evidence of this circular motion seems very slight.

Baldock from the south-west, and its passage is marked in a meadow of Mr. Lowe's by the branches torn off the trees and strewn in all directions over the meadow. Next, the maltings, belonging to Mr. Thomas Pryor, of the Park, Baldock, in the occupation of Mr. Page, standing on ground adjoining the farm homestead of Mr. Lowe, fell a prey to its fury. These maltings are of modern construction, having been built about fourteen years ago on the site of maltings which were then destroyed by fire. The buildings of which these maltings form part consist of a long malt warehouse and drying kilns, running from east to west, probably about 200 feet in extent. From this building three maltings branch out at right angles from south to north, thus presenting their broad side to the whole force of the storm, and sustaining, as the sequel will show, nearly the whole of the damage. The malting which was first injured is a building 150 feet long, by 44 feet broad. The damage to this structure appears to have been caused by the pressure of the wind on the outside of the roof, for all the windows were shut and the appearance the roof presented just after the occurrence seems to point to this conclusion.[2] The centre of the roof for, perhaps, 100 feet was crushed inwards, and the walls above the ground floor were pushed over and lay on the floor above. Half the roof rested on the upper floor, while the other half with the wall on the east side were precipitated and lying, at the time of our visit, in a heap of ruins in the intervening space between this and the next building. The barley loft next Mr. Lowe's farm has resisted the storm and is still standing, but the wind, by its pressure on the roof, has swayed the end wall so much that it is doubtful whether the upper portion will not have to be rebuilt.[3] The lower floor has sustained no injury. The centre malting was of considerable dimensions, about 100 feet long by 50 broad. The damage done to this is nearly entirely confined to the roof. It appears that one of the maltsters was working in this building in the morning, and consequently the side shutters were all open. The wind, entering by these apertures, separated the east half of the roof from the other half longitudinally and quite lifted it with the boards and rafters from the main principals and framework. These latter, except one, remain in position and, with the western half of the roof, are almost intact. It is stated that it took 30 tons of slates to cover the rafters, so that the wind must have had sufficient force to lift fifteen tons besides the rafters and boarding, and to turn them completely over into the yard below. The roof of the drying kiln, which joins the end of this malting, is tiled, and a portion of it appears to have been lifted up simultaneously with that of the malting, and the two coming in contact fell on to the upper stage of the malting with so much force as to break one of the principals —a beam 11 inches deep by 6 inches thick—and the *debris*, probably several tons in weight, remained, at the time of our visit, a confused heap of tiles, slates, rafters, beams, and boards. The covering to the kiln technically termed a mushroom, or kimberlo, with the iron work which supported it, was lifted out of its place by the wind and deposited on this heap. The general appearance of the interior of this malting bears out the theory that the force of the storm was expended internally and that the roof facing towards Hitchin was strong enough to resist the outside pressure.[4] The malting by the side of the road leading to Willian has suffered much in the same way as the one first described. The storm has crushed in the roof from the outside, carrying inwards the west wall and forcing out a portion of the upper wall by the roadside and half the roof to the ground beneath. Some of the principals and framing of this roof were forced

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[2] This can hardly be admitted, as the pitch of the roof on the side whence the wind came is almost perfect, merely lifted bodily eastward, and allowed to fall because several of the principals broke when dropped upon the wall on the east side. The west wall appears to have been drawn over by the pull of the roof.

[3] This is a very important fact, for this building was full of barley to within a few eet of the ridge, hence this building hardly contained any air and it sustained scarcely ny damage.

[4] It is very satisfactory to find that the writer of this description has here enunciated the very theory we had been led to adopt.

through and embedded in the outer wall.[5] It was the custom for a brass band to practise here, and the forms where the musicians sat and the lamps they had last used were there, after the storm had spent its fury on the building, uninjured. The road was almost impassable for a time from the accumulation of rafters, boards, bricks, and tiles; the trees in the park on the other side, besides being damaged and torn about by the raging of the wind, had their branches filled with slates and broken rafters; and in the meadow beyond a large piece of roof had fallen, giving evidence of the great violence and power of the storm. The buildings, viewed from the top of one of the dismantled maltings, presented a most remarkable sight. The roofs of the outside maltings had been torn asunder for, perhaps, 80 feet of their length, and at each end the jagged ends of boards and protruding beams and rafters gave the idea that a terrible railway accident might have happened there. The ruin was almost as complete as if a fire had again occurred, but without the consolation that follows from a fire insurance. It was fortunate that the malt lofts, which stood end ways to the storm, resisted its force, for a considerable quantity of malt was in store, and the loss would have been much more serious had the buildings containing it been damaged like the maltings. As it was, scarcely any malt was lost or damaged. It is fortunate also that the catastrophe happened at a time of year when no malting was being carried on. If the storm had occurred in the autumn or winter probably Mr. Page would have sustained great inconvenience and loss.

The trees in the park on the other side of the road were torn and large arms were twisted off them, but at this point the whirlwind appears to have risen, and no more damage was done until it reached the other side of Baldock, where a tree was torn up by the roots and other trees were much damaged.

Mr. T. B. Latchmore, of Hitchin, has photographed the damaged maltings, and no doubt the vivid representation of the catastrophe will ensure a large sale. —*Hertfordshire Express*, June 19th.

We must also here insert a letter with which we have been favoured by Mr. Lucas, and a few scraps of miscellaneous information :—

SIR,—I hope your expedition on Tuesday last to the scene of devastation at Baldock was not unproductive. Since I saw you I have learned a few details of the course of the storm. At Little Offley (where I have established a rain gauge), 3 miles S.W., in addition to the wind which damaged trees very much, there was a most extraordinary hailstorm, many hailstones being considerably over an inch across, and being star-shaped. Out of curiosity Mr. Lawson's bailiff weighed some of them, and 123 hailstones weighed $\frac{3}{4}$-lb; this was at Lilly, one mile S.W. of Little Offley. The hurricane crossed the Bedford-road half-a-mile N. of Hitchin, damaging a house, then did great damage in what we call "Fishpond Closes," went on to Grove Mill, damaging the poplar trees there, and then over an open country —I presume, to Baldock—on to Royston, where it appears to have done considerable damage.—Yours faithfully, W. LUCAS.

Hitchin, 21st June, 1875.

HITCHIN.—TERRIFIC STORM.—About twenty minutes to two on Saturday afternoon a westerly hurricane of unusual violence swept over a portion of this town and district. The beautiful trees in that portion of the place known as the Fishponds were much damaged. Huge boughs were torn off, tossed up in the air to a considerable height, and carried a great distance. No damage was done to

[5] The appearances are correctly described, but we believe that the roof was raised bodily a foot or two and lifted eastwards, thereby drawing over the west wall and explaining the sawn appearance which the bricks had where unbroken principals had cut their way down through even three courses of bricks.

house property, beyond the carrying away of a few tiles and chimney pots.—*Leighton Observer.*

HITCHIN.—On Saturday afternoon, about twenty minutes to two, a westerly hurricane of terrific fury, passed over a portion of this town. Near the Union a few tiles were taken off the roofs of cottages, and some slight damage was done to Mr. Richardson's back premises in the Bedford-road. The trees in the Fishponds suffered much, the tops of many being wrenched off, and tossed high in the air and then carried some distance. Passing in the direction of Grove Mill, the trees easily succumbed to the wind, and the tall poplars at the latter place were much damaged.

Between Letchworth and Baldock a man had been at work on a straw stack, but at the time of the hurricane he was fortunately away, for when he returned he found the stack scattered all over the field. Another man was violently thrown against a gate, to which he had to cling until the hurricane passed.

At Baldock there was a very serious destruction of property, and it seems miraculous that there was no loss of life. Mr. R. Page's malting, situate near Mr. Lowe's farm, was almost entirely unroofed. The building covers more than an acre of ground and was substantially built, being only about 15 years old. It consisted of three buildings 155 ft. long and 45 ft. wide, running parallel, and joined at one end. In the end storehouses was 500 quarters of malt, but the other houses were undergoing a thorough cleansing. On Saturday afternoon no one was at work upon the premises, or there must have been loss of life. An eye witness says, about twenty minutes to two, whilst near the maltings, he heard a noise as of thunder, accompanied by the snapping of trees, and on looking round he saw the trees falling a prey to the furious wind. Quickly it came on and caught the maltings broadside. All the windows were open, and the wind entering there, the roof was lifted into the yard between the next block of buildings. The heavy rafters were torn out, brickwork gave way, and the slates were carried a long distance. The two other buildings shared the same fate, the roof of the outside one being deposited in a slanting position into the adjoining road. The air was filled with *débris*, and the trees in the beautiful avenue opposite, next fell before the rapacious wind, completely blocking up the roadway. The property belongs to Mr. Thomas Pryor, and is in the occupation of Mr. R. Page. It is estimated that the damage done will exceed a thousand pounds. As a proof of the fury of the hurricane, we may mention that slates from the roof were carried some distance, and then deeply driven into the trunks of the trees. Some of the wood was carried a distance of 500 yards.

From Royston a correspondent writes to say that about 15 cwt. of lead on the roof of the church was rolled up "like a pipe light." A very high chimney stack at the Priory, the residence of Joseph Phillips, Esq., was blown on to the roof, breaking through from gable to eaves, but fortunately no one was hurt. A very fine chestnut tree, belonging to the Rev. Medway, had a large arm blown off, which was carried a distance of thirty or forty yards.—*Herts. and S. Beds. Journal.*

We had intended to give a map of the path of the whirlwind, but the country traversed presented so few objects which could be affected, that the injury, except at Baldock, is very slight, while the length of the track is quite 19 miles. The following are the details of the traces above recorded. Assumed line of centre of whirlwind extends from 4 miles W.S.W. of Hitchin to Royston. Its direction was from W. 28° S. to E. 28° N., or, roughly, from W.S.W. to E.N.E.

The first trace is at Lilley (lat. 51° 56′ N., lon. 0° 23′ W.), distance from assumed path (which commences here) 0·7 mile N. At Little Offley (1½ miles from commencement of track) damage was done 0·6 miles N. of path. Hitchin Fishponds are 4·3 miles along the path, and absolutely on it. Grove Mill is 4·9 miles along and 0·1 mile N. of path. The scattered hayrick, in Letchworth parish, was 7 miles

along and 0·1 mile N. of path. The maltings at Baldock are 8·7 miles along and absolutely on the path, but the two trees on the other side of Baldock, and 9·3 miles along, are 0·2 mile (350 yards) S. of the path. Lastly, Royston forms the extremity of the path. The close agreement of all these cases with a rigorously straight line is remarkable.

In the next place we must say a few words respecting the illustrations, premising that nothing but Latchmore's large photographs would give anyone an idea of the wreck at Baldock. The length of these remarks is much reduced by the accuracy of the description quoted above from the *Hertfordshire Express*, which we need only supplement. Each building consisted of two floors, the upper of which had no ceiling but the roof. The end of each range is cut off from the long malting floor by a vertical wall, and none of these end buildings was unroofed. The most westerly range, which was first struck, is represented in the engraving.

The whole of this roof (A) was either lifted and dropped, or else pushed about 4 ft. eastwards, the walls from the level of the upper floor to the eaves of the roof were thrown over eastwards, the west one falling on to the floor just mentioned, and the east wall of course falling outwards into the yard. From the fact that the bricks of the west wall were not in the least disarranged (they lay quite ready for rebuilding), and that the slates on that side were almost free from injury, we cannot believe that the roof was pushed bodily eastwards by a westerly wind. It is well known that the passage of a whirlwind over a pond will empty it (*e.g.* see *Met. Mag.*, vol. viii., p. 168); now this means that it will raise many tons of water, for 36 cubic feet of water weigh a ton, therefore a pond 20 ft. in diameter, and 2 feet deep, would contain nearly 20 tons of water. Again, from what we know of the rate of diminution of pressure in the greater whirlwinds which we call cyclones, it is surely not unreasonable to assume that in the very limited area and high intensity of a true whirlwind there is a diminution of pressure of half an inch of mercury. If so, as half an inch of mercury represents a quarter of a pound on each square inch of surface, or 36lbs. on each square foot, we should have the diminution over the damaged part of this building, say 120 ft. by 40 ft, or 4,800 feet = (4800 × 36 =) 172800 lbs. or 77 tons, whereas the slates and timber probably only weighed about half that amount.

Without wishing in any way to dogmatize upon the subject, we must express our belief that the passage of the whirlwind produced such a diminution of pressure as caused the air in the building to expand, and to lift the roof, and that the motion of translation of the whirlwind caused it to be dropped about 4 ft. further eastwards than its original position.

The damage to the second range of buildings (B), though quite different to that done to the first, is capable of similar explanation—in fact, it is remarked by the reporter that "*the force of the storm was expended internally.*" Both walls, the principals, and nearly every slate on the

side from which the storm came, were undisturbed; but of the eastern slope of the roof not a vestige remained—rafters, boards, and slates had all gone, as cleanly and neatly as if they had been purposely removed.

The third range (C) suffered very much in the same manner as the first, but there was one feature in which difference existed—the east wall was not thrown into the lane, as it should have been to render the similarity perfect, and several of the principals had sawn their way (no other term so well expresses the appearance) through two and even three courses of bricks. We do not know why this difference occurred, there are obviously two explanations, but perhaps neither is correct. It may have been that the wall, being the outer one of the premises, was built with better materials than the others, but the whole of the buildings were very substantial—otherwise, for instance, the upper floor of the first building could not have supported the roof in the position shown in the engraving. Another explanation is that perhaps the whirlwind was rising rapidly when it reached the last range of buildings, and therefore exerted lifting rather than tractional power.

Lastly, there remains the transverse building (D), and its almost perfect immunity to be considered. Here, again, two explanations offer themselves. It may have been that the whirlwind did not pass over it, or it may have been—and we incline to the opinion—that inasmuch as the building was full of malt far above the eaves, and nearly to the ridge, there was not enough air inside to produce sufficient expansive force to lift the roof.

Looking at the slates sticking in the trees like so many axe heads, it would be ridiculous to deny that there was a very strong wind; but the impression left upon our mind is that the prime cause of the disaster was the expansion of the air inside the large malting floors, consequent upon the sudden passage over them of a whirlwind, in the centre of which the atmospheric pressure was greatly diminished.

We must not conclude without expressing our thanks to Mr. Page, the occupier, for the courteous assistance which he has given us, both when inspecting the ruins and subsequently.

WHIRLWIND IN SHROPSHIRE, JULY 6TH.

To the Editor of the Meteorological Magazine.

SIR,—I beg to send you an account of a whirlwind which was witnessed here yesterday by several of my friends, from whom I have the account, and upon whom I can rely for its truth.

About 4.30 p.m. on the 6th inst. (wind, light breeze from E.) a whirlwind was seen crossing from E. to W. a field of 10 or 12 acres, on which was lying loosely a crop of hay nearly made, and collecting a great quantity in its passage. A portion of the hay so collected was carried over the hedge, and deposited in the adjoining field; but the greater quantity—estimated at from 2 to 3 cwt.—was whirled to a

height of 200 feet into the air, and carried in a bulk at a great speed over an adjoining hill, half-a-mile distant, where it was lost sight of, part of the hay being caught by some trees on the summit, but without apparently breaking the form, which was undefinable.

Weather at the time very hot, with sun shining.

Although these winds are not rare, yet circumstances combine to render this one noticeable, as not only are they seldom observed in this locality, but, some years ago, during the building of a church a few yards distant from the same field, a wind of a similar character occurred, and a serious accident was the result, viz., the demolition of the partly finished roof of the church, and injury to the workmen engaged on it.—I am, Sir, yours &c.,

E. GRIFFITHS.

Bishop's Castle, Salop, 7th July, 1875.

REDUCTION OF BAROMETER READINGS TO SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—May I offer a few remarks on a subject alluded to by a correspondent in the May number of your magazine—viz., the reduction of barometrical observations to the sea level.

I suppose the correction mentioned as deduced from Sir Geo. Shuckburgh's formula is intended to apply to the *mean* height of the barometer. It is plain that the correction itself must vary as the height of the barometer at the place of observation varies.

It seems to me that a simple method of obtaining the correction required at any place, and for any reading of the barometer, may be derived from the tables, or the formula, for determining the heights by the barometer.

1.—Thus to take (*e.g.*) the tables supplied by the Astronomer Royal to Messrs. Negretti and Zambra for the graduation of their aneroids. Let M be the number of feet in the table answering to the reading of the barometer at the place of observation (corrected for temperature); N the number of feet corresponding to the (required) reading at the sea level; c the corrective factor for the mean temperature of the air; h the known height above the sea level of the place of observation; then

$$h=(\mathrm{M}-\mathrm{N})\ (1+c)\quad \text{or, } \mathrm{N}=\mathrm{M}-\frac{h}{1+c}$$

Now since

$$\frac{1}{1+c}=1-c+c^2-c^3+\&c.$$

and c is small, being in fact

$$=\frac{2\ \text{mean temp.}\ -100}{1000}$$

We may take $\mathrm{N}=\mathrm{M}-h\ (1-c)$ nearly, when h is not very large.

Then N being determined from this formula, we can find in the table

the barometric pressure corresponding to it, *i.e.*, the pressure at the sea level.

The only difficulty is in the determination of the mean temperature, *i.e.*, what increase of temperature is to be assumed for the sea level. I do not know whether the rule given by Herschell ("Meteorology," p. 22) is still generally followed, viz., to allow 1° of temperature for 300 ft. of height. But taking the best known rule, if t be the temperature observed, T the difference to be allowed for the height (which is constant) then

$$c = \frac{2t + T - 100}{1000}$$

This method will, I think, give the barometric reading correctly as far as *hundredths* of an inch.

2.— If greater accuracy is desired, one might use the formula (from Baily's "Astronomical Tables") given in the Admiralty "Manual of Scientific Enquiry," p. 156. The formula is

$$\log h = A + C + \log D$$

where

$$D = \log B - \log B'.$$

B, B', being the readings of the barometer at the lower and upper stations, A and C being corrections (for which tables are given) depending upon temperature and latitude. From that formula we have

$$\log D = \log h - (A + C)$$

and

$$\log B = D + \log B'$$

whence (with the help of a table of logarithms), B, or the required barometric pressure at the sea level, may readily be found.

It would not be difficult for an observer to construct from this formula a table *for his own place of observation*, which would give the reading of the barometer at the sea level corrresponding to any observed reading and any temperature.—Yours faithfully,

J. G. H.

EXCESSIVE RAINFALL.

To the Editor of the Meteorological Magazine.

SIR,—The rainfall of June and the early part of July in the present year, has been somewhat interesting, especially in connexion with the disastrous floods in France. It is well known that generally in June the European or Continental summer rains set in, and these appear to have commenced in the south-east of England on or about the 10th of June, and to have continued here until the 21st. During these twelve days 2·10 inches of rain was registered, 0·75 inch having fallen during the 24 hours preceding 9 a.m. of the 18th. Five dry days followed, when a second group of eight days set in on June 27th, and continued to July 4th, the quantity registered being 2·18 inches,

0·81 inch having fallen during the 24 hours preceding 9 a.m. of the 4th July. The aggregate quantity during the two groups amounted to 4·28 inches.

The fall of rain at this station during the recent June has exceeded that of any previous June, 1871 to 1875, by 0·15 inch, 2·83 inches being the quantity registered in June, 1871.

The excessive rainfall of the 25 days, June 10th to July 4th, 1875, is best appreciated by a comparison of the rainfall as registered here during the same 25 days in the years 1871 to 1875. The numbers are as follows:—1871, 3·185 inches; 1872, 0·975 inches; 1873, 2·320 inches; 1874, 1·335 inches; 1875, 4·280 inches. Excess of 1875 above 1871, 1·095 inches.

It may probably interest some of your readers to make similar comparisons from their own journals.

I am, Sir, your obedient servant,

W. R. BIRT.

Cynthia Villa, Walthamstow, July 8, 1875.

SUPPLEMENTARY TABLE OF RAINFALL IN JUNE, 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·49	Gainford	1·98
Hailsham	2·89	Shap	4·24
Strathfield Turgiss	3·04	Llanfrechfa	5·54
Addington Manor	3·36	Castle Malgwyn	2·45
Oxford	2·97	Heyope	3·66
Cambridge	3·46	Melrose	3·25
Sheering	3·18	Cessnock, Glasgow	2·74
Ipswich	2·80	Gruinart	2·18
Diss	2·16	Keith	2·20
Swaffham	2·08	Strathconan	2·13
Compton Bassett	3·22	Springfield, Tain	2·11
Hessary Tor, Dartmoor	8·25	Skibbereen	3·14
Teignmouth	3·70	Fermoy	3·96
Torrington	5·10	Kilrush	5·06
Trevarrick, St. Austell	3·67	Kilkenny	2·78
Taunton	3·02	Kilsallaghan	2·82
Cheadle	3·13	Twyford, Athlone	3·07
Ashby de la Zouch	3·47	Ballinasloe	3·80
Coston, Melton Mowbray	2·88	Kylemore	7·45
Bucknall	2·51	Bangor	4·64
Mansfield	2·63	Carrick on Shannon	5·04
Walton, Liverpool	2·96	Warrenpoint	4·74
Broughton-in-Furness	4·83	Bushmills	2·98
Stanley, Wakefield	3·52		

UPPER-CURRENTS OVER AREAS OF DEPRESSION.

To the Editor of the Meteorological Magazine.

SIR,—I make no apology for asking you to insert the accompanying extract from a letter to M. H. Hildebrandsson on some points touched upon in his "Essai sur les courants supérieurs de l'atmosphère." because, whether my own theory be correct or otherwise, the attention devoted by meteorologists in our country to the upper-current circulation is still sadly unequal to the importance of the subject.

Yours truly,

W. CLEMENT LEY.

"I have now a collection of several thousand cirrus observations, chiefly made in the British Isles, arranged according to their relation to the distribution of atmospheric pressure at the earth's surface, and am engaged in their discussion. I may say that the results of my investigations hitherto are in close accordance with the principal results described in your Essay.

"Only on one point I must still differ from you. The more observations I accumulate the more firmly I am convinced that, at least as regards the British Isles, the axis of a cyclonic circulation commonly inclines backwards. When I wrote the 'Laws of the Winds prevailing in Western Europe,' my observations were comparatively few in number. Since that time I have made and obtained a large number, and possess many simultaneous observations taken in different places. The year 1872 alone, when depression-centres were unusually numerous in Great Britain and Ireland, furnished upwards of 70 observations of cirrus made over the centre of the bourrasque existing at the earth's surface. In very nearly all cases an upper current lay over the depression-centre, which upper current was *nearly* in accordance with the current *previously* experienced at the earth's surface, *e.g.*, in a depression travelling to N. it was from some south-easterly point; in a depression travelling to E., from a S. or S.W. point. Thus the westerly wind in the former case, and the northerly in the latter, appeared to occur in the lower regions of the atmosphere before they reached the higher.

"Similarly, in several instances in which an anticyclone has followed in the immediate wake of a cyclone, I have noticed a N. or N.W. upper current to exist over the central calm of the anticyclone.

"I am quite aware of the complexity of the investigation arising from the fact that the upper currents flowing off one area of depression cannot always be distinguished from those which form part of another. But it is in the largest, the best defined, and the most isolated depressions that the phenomenon I have described is most clearly observed.

"It was this phenomenon that was one of the first things which led me to adopt the conclusion (which I still believe to be correct) that the eastward motion of our depressions is not so much due to the prevailing force of the westerly currents acting as a *vis a tergo*, as to the fact that the depression perpetually *reproduces itself* to the eastward of its former position, such reproduction being due to changes of

tension taking place primarily in the lower strata. To this theory your remark, that friction will retard the motion of the inferior part of the depression, does not apply; to any other it would.

"Although, however, I believe that the central calm of a depression on the earth's surface is in advance of the corresponding calm in the higher regions, it appears to me that the whole disturbance or circulation of air is frequently of greater extent in the higher than in the inferior region. Consequently, when a depression is approaching, even though its axis inclines backwards, the banks or belts of cirrus, travelling from S.W., W., or N.W., may frequently be observed overhead, a little *before* the S. or S.E. wind has commenced on the earth's surface.—I remain, yours respectfully.—W. CLEMENT LEY."

REVIEW.

Annales de l'Observatoire Physique centrale de Russie publiées, par H. WILD. Année 1869; 4to.; St. Petersburg, 1874.

Annalen des Physikalischen Centralobservatoriums herausgegeben, von H. WILD. Jahrgang, 1873; 4to.; St. Petersburgh, 1875.

DR. WILD is not only keeping up current work, but he is also working up arrears. We have previously noticed his annual volumes for 1870-1 and 2 at considerable length. We have now before us those for 1869 and 1873, that for 1868 has failed to reach us, but it has evidently been published, because Dr. Wild says in the preface—

"The Annals of the Observatory for the year 1869, which I now present to the public, are reduced on precisely the same principles, and with the same precautions as those of the previous year."

The relative bulk of the volumes now before us indicate very approximately the development of the Russian Metorological system.

The 1869 volume is useful chiefly as prolonging the series backwards, and because its supplement contains a valuable series of daily observations at Naronowo (near Novgorod), from 1854 to 1862.

It differs from all the later volumes in that the letterpress is in Russian and French, whereas the later volumes are in Russian and German.

The volume for 1873 is a great work, great in bulk, for it consists of 793 quarto pages, and great in the area of country it represents, for it includes stations differing by 40° in latitude and by 120° in longitude, say, roughly, one-thirtieth of the entire surface of the globe. The volume is also great as regards the quantity of work put into it, for it is arranged on the Vienna pattern, and is perhaps the most compressed mass of meteorological data yet published. At the same time it is scarcely anything but a storehouse of well-arranged facts, and if we had not in pleasant remembrance the excellent papers which Dr. Wild and his staff contribute to the *Repertorium*, and for which papers volumes such as this are useful, if not necessary, we should be sorely tempted to enquire whether the persons who actually *use* the data thus published are sufficiently numerous to justify the great cost (in England it would probably be £600 or £700) of printing it.

JUNE, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	2·41	+ ·64	·56	30	15	85·1	9	43·3	1	0	0
II.		Maidstone (Linton Park)	2·30	— ·44	·65	11	10	83·0	3, 8	47·0	20*	0	0
,,		Selborne (The Wakes)	3·60	+ ·37	·84	21	15	75·4	4	39·5	1	0	0
III.		Hitchen	2·75	+ ·11	·42	29	18	75·0	3	41·0	21	0	...
,,		Banbury	2·97	— ·31	·46	17	13	79·0	3	40·0	1	0	...
IV.		Bury St. Edmunds (Culford)	2·83	+ ·25	·41	10	15	81·0	4	39·0	21	0	0
V.		Bridport	2·39	— ·85	·55	30	12	77·0	2	39·0	19	0	..
,,		Barnstaple	4·01	— ·11	·66	15	19	80·0	3, 4	47·0	5	0	...
,,		Bodmin	3·54	— ·50	·44	13	21	73·0	3	47·0	22	0	0
VI.		Cirencester	3·42	+ ·04	·43	27	14	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	2·63	— ·48	·58	29	14	75·0	3	41·0	1	0	0
,,		Tenbury (Orleton)	2·32	— 1·20	·47	10	15	79·5	3	39·2	22	0	0
VII.		Leicester (Belmont Villas)	4·35	...	1·67	29	15	84·2	3	41·0	1	0	...
,,		Boston	...	...	...	...	...	...	...	...	...	...	...
,,		Grimsby (Killingholme)	3·07	...	1·40	29	14	74·5	25	43·0	1	0	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	...
VIII.		Manchester	3·56	+ ·22	..	..	19	...	...	...	...	...	...
IX.		York	2·10	+ ·20	·56	28	15	...	...	...	...	...	...
,,		Skipton (Arncliffe)	4·65	+ ·55	·53	15	19	75·0	24	38·0	26	0	...
X.		North Shields	1·57	— 1·17	·49	29	14	73·6	25	42·0	2	0	..
,,		Borrowdale (Seathwaite)	10·90	+ ·39	1·42	14	21	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	..	...	...	...	...	...	...	...
,,		Haverfordwest	3·39	— ·26	·58	8	17	76·0	2	43·0	26	0	...
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	..	...
,,		Llandudno	1·81	— ·48	·33	14	16	74·9	3	45·4	1, 2	0	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	3·89	+ 1·06	1·00	15	21	75·8	4	39·8	1	0	0
,,		Hawick (Silverbut Hall)	2·76	...	·36	30	17	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	...	...	...	...	...	...	...	...	...	...	...
XV.		Castle Toward	2·94	— ·55	·51	16	19	73·5	3	...	...	...	...
XVI.		Leven (Nookton)	2·41	+ ·17	·50	14	18	71·0	24	38·0	1, 3	0	5
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,		Grandtully	2·86	...	·29	13	18	...	...	..	...	...	...
XVII.		Braemar	2·00	— 1·44	·37	16	14	75·7	2	33·3	14	0	7
,,		Aberdeen	3·36	...	·89	26	19	74·0	24	38·0	14	0	0
XVIII		Loch Broom	3·05	...	·35	5	23	...	...	...	...	...	..
,,		Portree	4·81	+ ·03	·92	14	23	...	...	...	...	..	...
,,		Inverness (Culloden)	1·58	— ·34	·46	14	17	67·9	1	39·9	12	0	2
XIX.		Helmsdale	1·83	...	·51	14	16	...	...	...	...	...	...
,,		Sandwick	1·45	— ·09	·42	14	14	65·2	4	43·7	13†	0	0
XX.	IRELAND.	Caherciveen Darrynane Abbey	5·37	...	·83	8	19	...	...	...	...	...	...
,,		Cork	3·01	...	·54	9	14	...	...	...	...	...	...
,,		Waterford	3·27	+ ·28	·45	27	22	75·0	3	42·0	11	0	...
,,		Killaloe	4·97	+ 1·34	·77	9	23	78·0	2	41·0	20	.	...
XXI.		Portarlington	2·29	— ·96	·40	15	23	73·0	24	41·5	20	0	...
,,		Monkstown, Dublin	2·29	— ·32	·30	11	...	...	...	...	...	...	...
XXII.		Galway	3·91	...	·46	13	25	78·0	2	44·0	29	0	...
,,		Ballyshannon	3·43	...	·50	27	19	...	...	...	...	...	...
XXIII		Waringstown	3·51	...	·63	14	20	77·0	3	40·0	4‡	0	0
,,		Edenfel (Omagh)	2·64	...	·43	27	17	71·0	3	36·0	20	0	0

* And 22. † 14. ‡ 18, 21.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON JUNE.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—The first ten days very dry, and often hot; the unusual occurrence of brisk winds, with T, took place on the 11th, and very high winds, for June, followed for some days after, with some showers. Dry weather commenced again on the 17th, and continued with only one intermission until the 28th, on which and two following days nearly 1 in. of R fell. Bar. generally steady; wind mostly S. and S.W. The R at the end of the month very beneficial.

SELBORNE.—Distant T from 11 a.m. to 3 p.m. on 9th; T S in the morning of 21st, and heavy R till the evening; T S, with H, on 18th; T on 11th, 12th, 28th, 29th, and 30th; fog on 4th and 25th; heavy dew on evening of 16th; a water-spout observed at Alton on 17th. Much hay spoilt through premature cutting. Prevailing winds S.W. almost all the month.

HITCHIN.—The stormiest June I ever remember, and most T and H, with high gales; on the 29th, the ground looked as though under S, owing to heavy H.

BANBURY.—T SS on 3rd, 4th, 9th, and 17th; that on the 17th was very violent, but very limited in extent, hardly reaching beyond the river Cherwell, into Northamptonshire, and not extending two miles on the S. and W.; much R and H fell, and a barn and cottage were struck by L, and set on fire; T on 29th.

CULFORD.—Easterly winds prevailed during the first and last week, and westerly during the middle of the month. Mean temp. 59°·3. T on 9th, 11th, 16th, 17th, 18th, and 28th.

BRIDPORT.—A fine warm month, with refreshing showers. The greater portion of the hay harvest secured, and the crop exceptionally heavy.

SHIFNAL.—The drought of May lasted till the 9th of June, with N.E. winds, and a bright sun for four days, when it changed to S.W., followed by copious R to 16th, lowering the temp. about 7° to 63°—65°, at which it continued, with two exceptions (24th and 25th), till the close. On the 27th the R which had ceased, returned still more copiously, and continued daily till the 30th; nearly a continuous fall from 4 p.m. on 27th to 11 a.m. on 30th. Total 1·32 in. T in the distance on 20th. Grain crops coming early into ear with short straw. Swedes and mangel-wurzel saved by the R.

ORLETON.—A pleasant month, and very favorable for all the growing crops, with a rainfall of nearly the average quantity, occurring chiefly between the 8th and 18th, and 26th and 30th. Mean temp. very near the average of the month. T heard 3rd, 9th, 10th, 11th, 17th, and 29th, and L seen on 3rd, 9th, and 17th, but no heavy storms. The wind frequently strong; violent on 15th. Wheat coming into ear about the 14th, and into blossom about the 26th.

LEICESTER.—Very fine and warm during the first week, then showery till 19th. Very heavy R, with T S in afternoon, on 29th; the heaviest falls were between 1.50 and 2.10 p.m., and between 3.20 and 3.40 p.m.; total fall in 24 hours, 1·67 in.. Total fall in the half year ending June 30th, 12·08 in.; the average at Wigston being 11·61 in.; the excess is 0·47 in. T S at 11.30 a.m. on 9th; at 9.20 a.m. on 11th; and at 10.30 p.m. on 17th.

GRIMSBY.—Distant T on 4th and 17th; T at 4 p.m. on 9th, at mid-day on 11th, at mid-day, with high wind in evening, on 15th, in the afternoon of 21st and morning of 29th. Heavy R in some parts of the county on the 17th, but not any here. A splendid fall of 1·40 in. of R here on 29th. Dog rose in flower on 6th.

ARNCLIFFE.—T S on 13th and 14th.

NORTH SHIELDS.—T on 12th, and two T SS on 15th.

SEATHWAITE.—T on 15th, 16th, and 29th; H on 9th and 16th.

WALES.

HAVERFORDWEST.—The first three days and the last day were warm and genial; temp. over 70°; all the rest of the month was chilly, cloudy, and wet; temp. during the day seldom rising above 60°. Grass and hay abundant, but weather very trying for securing the hay. Prevailing wind westerly.

LLANDUDNO.—Privet in flower on 18th; wheat and barley on 16th. Hay harvest begun on 21st. With the exception of a few cold days between 10th and 16th, June was a fine genial month, its mean temp. rather more than 1° above the average, and its rainfall below it.

SCOTLAND.

DUMFRIES.—Winds chiefly W. and S.W.; rather cold from 4th to 11th. Temp. variable, and nearly 2° below that of last June; the latter half of the month was the warmest. R frequent, but with one exception (1·00 on 15th), not heavy; no T S.

HAWICK.—Slight T SS on the mornings of 4th and 14th. The month has been a genial and warm one, and there is a splendid crop of hay.

CASTLE TOWARD.—Turnip sowing completed in this district, and the cutting of hay begun; all crops look well.

BRAEMAR.—T and H at 5 p.m. on 12th, and T at 2 p.m. on 16th. A month of excellent weather throughout.

ABERDEEN.—A month of quiet, mild, but showery weather. Fog on 2nd, 6th, and 30th. T S in early morning on 6th, and another on 12th; H on 16th and 26th. Bar., temp., and pressure of wind all below the average; rainfall above it.

LOCHBROOM.—Splendid weather, sunshine and showers alternating; grass, potatoes, and all crops looking luxuriant and promising; and on the whole it has been the finest June we have had for years.

PORTREE.—A fine growing month, although a little wet for turnip sowing. The crops look well everywhere.

SANDWICK.—June has been drier and warmer than the mean; the weather generally has been very pleasant; and vegetation has made great progress. The max. temp. in the shade ranged from 60° to 65° during 10 days, and in the sun from 110° to 115° during 6 days.

IRELAND.

DARRYNANE ABBEY.—Wettest June for 6 years. A foggy, cold month, delaying harvest operations much; and I am sorry to say that the blight is showing itself in the potatoe crop, though not to any extent.

BALLYSHANNON.—The temp. in the first part of the month was considerably below summer heat; the latter part has been more favorable to growth, heat and moisture coming together.

WARINGSTOWN.—The dripping weather during the first fortnight improved all crops, which now look flourishing; dry weather wanted for haymaking, which is backward.

EDENFEL, OMAGH.—Weather generally rainy and unsettled, and cool for the time of year, but the growth of the other crops has in no way been retarded, and there is every promise of an abundant harvest.

HEAVY FALL OF RAIN ON JUNE 29TH.

WE have received the following observations of the amounts of rain registered on June 29th, the greater part of which fell during thunderstorms in the afternoon and evening:—

Newport Pagnell, Bucks	2·76
Cardington, Beds.....	2·50
Leicester, Belmont Villas	1·67
Dunmow, Essex	1·46
Grimsby	1·40
Wakefield, Stanley Vicarage.....	1·33
Horncastle, Bucknall	1·08